The present invention relates to improvements made to the LED display that is the object of the main patent FR-87/15.888, dated November 10, 1987. It concerns a display with LEDs and dot matrices and in particular, a multicolored LED and dot matrix display unit that can be put together in any desired number to form a large display assembly with LEDs and dot matrices of a desired dimension.

These days, the LED display is largely used in all kinds of applications. Any type of colored image can be represented by a number of LED dots in the dot matrix with LEDs. One LED dot contains three "chips" with LEDs, in which the monochromatic lights are different, i.e., red, green and blue. Since all the colors can be created by the three lights with primary colors, with this type of dots with LEDs, any desired color can be obtained by mixing a different proportion of the three primary color lights.

Currently, only the red and green LED "chips" can be justified, since the blue "chip" with LEDs still remains extremely expensive to produce. For economic reasons, the majority of the types of LED displays sold contain only the red and green "chips" with LEDs (no blue). Due to the red and green "chips" with LEDs, we can create the colors called "warmer" such as yellow, orange, yellowish green and various intermediate colors located between them. Still without the component blue, the colors called "cooler", i.e., turquoise blue, magenta, violet or indigo must be sacrificed. Figure 9 shows a dot (D) of LEDs with a red "chip" (R) and a green "chip" (G) with LEDs.

Ordinarily, large colored and dynamic displays with LEDs and dot matrices are available, in which the image stored in a computer can be displayed in a dynamic form in accordance with the image reproduced on the monitor of a computer. The term "dynamic" indicates here that the scene on the display varies over time, like the scenes on a television screen. In the opposite sense, there is "static," which indicates that the scene on the display does not vary over time, similar to that of a photograph. With reference to figure 11, a large assembly of dynamic display with LEDs and dot matrices (L) contains a number of display devices with LEDs and dot matrices. In order to simplify, only nine devices (P11) to (P33) are reproduced in the example shown. At the time of actual use, the number of devices in a large display assembly with LEDs is generally far greater than nine. In fact, the resolution of nine devices defines the illustrated character of Bugs Bunny. The devices are standardized display elements with LEDs and dot matrices. Each device contains 8 x 8 = 64 dots (D) with LEDs. Each dot can include two "chips," red and green, as can be seen in figure 9, or three "chips," red, green and blue with LEDs. The formation of the image on the large display assembly (L) with LEDs is made by cyclic scanning of all the dots with LEDs of the large display assembly with LEDs and namely, from top to bottom. The scanning of the large display assembly with LEDs differs from that of a television screen, in the sense that the first is a scanning of lines at an angle, while the second is a scanning of the dots at an angle. Since scanning is a known technique, explaining it in detail is not necessary.

Given that the signals of the computer (C) are not suitable for

transmission over a distance that is fairly far from the computer (C) to a large display assembly (L) with LEDs, an interface (I) must be provided to transform the computer signals to a form that is appropriate for transmission over a relatively long line. The "image" of the computer is analyzed into a "half-tone" image formed by numerous (in the example 24 x 24 = 576) dots. The color (chrominance) and the brilliance (luminance) of each dot correspond to that of the adjacent dot of the image and depend on the brilliance of chips (R) and (G) with LEDs. The brilliance of a chip with LEDs can be divided, from completely saturated at its most brilliant range, into e.g., eight classes, namely O, L, M, N, P, Q, R and S. The brilliance of a chip depends on its power supply. The greater the power supply, the more brilliant the chip. If the brilliance of the red chip (R) with LEDs of a spot with LEDs is class M and that of its green chip (G) with LEDs is class P at any given time, the result will be a color brilliance MP. Due to the division into eight degrees of brilliance, we can obtain 8 x 8 = 64 different classes of color brilliance. Here we have to use the expression "color brilliance" instead of "color" to describe the 64 different classes, since we can not say that we have 64 different colors. Since the resulting coloration of the chromatic lights depends only on the proportion of primary monochromatic lights, the class LL and the class RR have the same color (yellow), but a different brilliance. The brilliance of the color of the dots with LEDs is controlled by the color brilliance signals (data), which are emitted at the corresponding dots by a data shift circuit (DS). The scanning of the lines is controlled by scanning signals of the lines, which activate the adjacent lines by way of a scanning control circuit (SC).

The line-scanning signals activate the 24 lines of dots with LEDs of the large display with LEDs and namely, one by one, from the top line (R1) to the bottom line (R24), and then repeats the same operation. When a given line (e.g., the first line of dots of the devices (P21), (P22), (P23) with LEDs, i.e., the new line (R9) of the large display assembly (L) with LEDs) is stressed, the dot data corresponding to the LEDs of this line (i.e., the signals for the color brilliance of these dots) are transmitted to 24 dots with LEDs of this line (R9). The control of the operation and the transmission of data are carried out by the software of a central unit. The output of the central unit is connected to a data shifting circuit (DS) by way of a buffer (B1) and to a random access memory (RAM) of which the output is connected to a scanning control circuit (SC) by way of another buffer (B2). The components included in the zone delimited by the broken lines, i.e., the central unit (CPU), the random access memory (RAM), the data offset circuit (DS), the scanning control circuit (SC) and the buffers (B1) (B2) form the control circuit (CC) of the large display assembly with LEDs and can be mounted on a single printed circuit board. A power stabilizer supplies the power to the control circuit. All the elements above are a known technology of the computer industry; because of that, describing them in detail is not necessary.

The software of the central unit (CPU) must be programmed in such a way that the twenty-four lines of dots would be scanned sequentially in a specific period, and when a line of dots is scanned by the scanning control circuit, the corresponding data, i.e., the color brilliance signal of the dots with LEDs on this line, are transmitted to the respective dots with LEDs.

In spite of the fact that this large display assembly with LEDs is largely used to an increasing extent, it presents several disadvantages. The first disadvantage is the inflexibility in its dimensions.

Since the large display assembly with LEDs is scanned as an entity having a defined number of lines and columns of dots, it can not be enlarged or reduced by adding or by eliminating certain display devices with LEDs and dot matrices, without changing the equipment and the software of the control circuit (CC). For example, if we bring the scale of the large display assembly with LEDs (L) to a circuit board with dot matrices of 32 x 32 = 1024 (i.e., containing 4 x 4 = 16 devices) or reduce its scale to a circuit board with dot matrices with 16 x 16 = 252, i.e., containing 2 x 2 = 4 devices, the new large display assembly with LEDs that results become incompatible with the original control circuit (CC). The reason is simple. We can not use a television receiver of the NTSC system (National Television System Committee) to receive the program of a television station of the SECAM system, since the number of lines and columns (scanning standard) of the two systems are different. In parallel, it is also impossible to use the control circuit (CC), which is specifically defined for a matrix of 24 x 24 dots to control a large display assembly with LEDs having a matrix of 32 x 32 or 16 x 16 dots. For this reason, if we want to increase the scale of the large display assembly with LEDs (L) to 32 x 32 dots, the buffers (B1), (B2), the data offset circuit (DS) and the scanning control circuit (SC) must be modified in order to match the thirty-two lines and the thirty-two columns of dots in the enlarged display

assembly with LEDs, and the software of the central unit must be reprogrammed in such a way that a scanning cycle can pass over thirty-two lines instead of thirty-four. In addition, the printed circuit boards which contain the elements (B1), (B2), (DS), (SC), the RAM memory and the central unit CPU have to be redesigned. This makes an economical modification of the dimensions of the large display assembly with LEDs (L) impossible. As a result, the dimensions and the specifications of the large display assembly with LEDs lack flexibility. If a specific dimension is only produced in a small number, the unit price of each piece will be extremely costly. Thus, only several specific standardized dimensions of the large display assembly with LEDs are available on the marked.

In addition to the impossibility of modifying its dimensions, another disadvantage of the dynamic and classic display with LEDs and dot matrices consists of its critical requirement of flatness of the LED devices and the impossibility of controlling the brilliance of the colors in a specific zone, or of a specific display device with LEDs, of a large display assembly (L) with LEDs. For the producers of the LED industry, there is a technical difficulty that it has not been possible to surmount to date. This means, the grade of the display device with LEDs is impossible to control to restrict its color brilliance to a defined value with precision, or to a very tight sequence during the production of the display device with LEDs. As a result, the color brilliance of the dots of a display device with LEDs (P11) may be very different from that of another display device (P12) with LEDs, more brilliant or weaker than the second one, or more red or more green than the second one, even if the two display devices with LEDs are excited by the same current and the same voltage. The inequality in the

color brilliance of the display device with LEDs can create less pleasant visual effects when the LED display is viewed. For example, if the color brilliance of the dots on device (P11) is weaker and less red than those on device (P13), Bugs Bunny the rabbit's right ear will appear unreasonably darker and more red than his left ear. As explained above, it is impossible to strictly control the resulting grade of a display device with LEDs in the course of its production; thus, we can not effectively produce a display device with LEDs of which the color brilliance meets our requirements. To make the color brilliance required match, we have no choice but to select a display device with LEDs from among several display devices with LEDs. The manufacturers, suppliers of display device with LEDs general classify their products according to several grades, e.g., ten, according to their color brilliance under the excitation of a standardized voltage. The manufacturers of large display assemblies with LEDs, the device consumers must select devices of the same grade, e.g., 5th grade, to construct a large display assembly of LEDs. Since all the devices must be strictly of the same grade, the manufacturers of the large displays with LEDs are liable to become "difficult" customers of the device suppliers since the former can never purchase anything but one specific grade of the products of the latter. Thus, the supplier may have to increase the price of the specific type of products of which relatively few are in reserve. In addition, the manufacturers of the large display assemblies of LEDs may sometimes displease customers due to a lack of the specific grade desired of the devices.

In addition, even if all the devices (P11) to (P33) are strictly chosen

in order to have the same grade of color brilliance, the entire surface of the resulting large display with LEDs may again not have exactly the same color brilliance when it is excited by the same voltage as a result of unforeseen factors. For example the device (P11) may be slightly darker than device (P13) when it is mounted in a large display assembly with LEDs, even if they were originally classified in the same color brilliance grade. In this case, a control of the brilliance of the individual devices is necessary. Still, since the entire large display assembly with LEDs of all the devices is scanned as one entity, the separate control of one device is impossible. We can control only the color brilliance of the large assembly with LEDs (L). In other words, we can only control the color brilliance of all the nine devices (P11) to (P33) at the same time, since the large display with LEDs (L) is scanned as one entity.

As a result, it is very desirable to be able to arrange a large display assembly with LEDs, which can be arbitrarily enlarged and reduced to the desired dimension without it being necessary to redesign all of the circuits. It is also desirable for the color brilliance of the different parts of a large display assembly with LEDs to be controlled separately in such a way that it would not be necessary for all the devices to have the same color brilliance grade and that the local inequality of the color brilliance of the large display assembly with LEDs could be eliminated in every specific area by local control.

In order to achieve this goal, the classic large display assembly with LEDs must be innovative in principle. The principle consists in that all the

dots of the display device with LEDs (P11) to (P33) would be scanned as one entity, which leads to inflexibility in the dimensions of the large display assembly with LEDs. Still, the principle is that the entire large display assembly with LEDs (L) is actuated by a single control circuit (CC) which makes it impossible to control the color and brilliance locally. As a result, it was necessary to abandon the principles of the classic dynamic large display assembly with LEDs and dot matrices.

According to the present invention, a large display assembly with LEDs according to the main claim of the main patent FR-87/15.888 is created by assembling a number of similar units. Each unit may contain N standardized devices 8 x 8 with dot matrices and LEDs, where N is a small whole positive number. The number N is preferably neither too large nor too small, the reason for this is explained below. For example, if a unit contains 2 x 4 = 8 devices, thus N = 8, and the resulting unit is a matrix of 16 x 32 = 512 dots. The principle of the present invention consists in that each unit has its own control circuit provided with an input channel and an output channel. Two units can be connected in series, i.e., the output of one unit is connected to the input of another unit, or in parallel, i.e., the inputs of the two units are connected together. Thus, we can connect any desired number of units to form a large display assembly with LEDs of a desired dimension. Each unit is scanned as an entity. In other words, for a unit of 16 x 32 points, the sixteen lines are scanned sequentially from the first line at the top to the sixteenth line at the bottom, the scanning is repeated up to the first line. Since all the units of the large display assembly with LEDs are scanned separately, we can arbitrarily modify the size of the large display assembly with LEDs by increasing or decreasing

its units without involving the problem of incompatibility.

Since each unit is scanned independently as one entity, the control circuit of each unit must contain the elements similar to those of the control circuit of the prior art. As a result, like the control circuit (CC) of the large display assembly with LEDs, the control circuit of each unit also includes a central unit, a random access memory, a scanning control circuit, a data offset circuit and the necessary buffers. In this respect, a unit according to the invention may be considered as a miniaturized classic large display assembly with LEDs (L) reproduced in figure 10. Each control circuit is excited by a power stabilizer or a power supply. The scanning control circuit carries out the cyclic scanning along the sixteen lines, while the data offset circuit transmits the data, color brilliance signals, to the 32 points of each corresponding line. The software of the central unit is specially programmed for a matrix with 16 x 32 dots. If the unit contains a different number of devices (e.g., 4 devices instead of 8, the software of the central unit (CPU) must be programmed to make its "scanning standard" coincide.

In order to regulate the color and the brilliance of the unit, the control circuit of each unit is also equipped with a color brilliance switching system. Since a unit is scanned as an entity, the individual units of the large display assembly with LEDs can be controlled separately, but the eight devices of the unit are all controlled at the same time and can not be controlled in a separate manner. In practice, the color brilliance switching

system includes several run/stop switches, of which the statuses correspond to the different degrees of color brilliance.

Since the individual units of the large display assembly with LEDs can be controlled separately, it is not necessary for all the devices of the large display assembly with LEDs to be of the same grade. Only the eight devices of the same unit must be of the same grade to insure the uniformity of the color and the brilliance of each unit. In addition, if certain parts of the large display assembly with LEDs are not equal, the units of these parts can be controlled separately in such a way as to conform to the remaining parts.

A problem that the large display assembly with LEDs composed of these units poses, is the manner in which a unit can selectively accept its own computer data while rejecting the data of the other units. In the large display assembly with LEDs (L) in figure 10, there is nothing but a single unit; in other words, the large display assembly with LEDs (L) is one "unit;" thus, this problem does not occur. Still, in the case of the present invention, each unit must be able to accept nothing but its own data and to reject data from the other units. With reference to figure 1A, a large display assembly with LEDs (L1) according to the invention is assumed, formed of 4 x 2 = 8 units (U1) to (U8), see circle L1, connected in series or in parallel; if the data of the unit (U6) are transmitted from the computer, they can be transmitted to all the units. For example, they can go from (U1), (U2) to (U6) or from (U1), (U3) and (U7) to (U8). Only unit (U6) can accept the data while the remaining units can reject the data that does not belong to them. For this reason, a unit must be able to identify whether the data transmitted belong to it or not. As a result, each unit must have an

"identification code" and the data transmitted are accompanied by an "address signal." When the identification code coincides with the address signal, a unit accepts the information transmitted. Otherwise, it rejects the information and allows it to pass. By acting in this way, the data of unit (U6) passes by unit (U1) without being accepted, then trifurcates toward (U2), (U3) and (U4), where the data are not accepted and come to (U5), (U6), (U7) and (U8), among which the data are not accepted except by unit (U6).

Before mounting the eight units (U1) to (U8) in their position on the large display assembly with LEDs (L1), we have to associate the positions of the units with the corresponding addresses in the computer memory in such a way that the data corresponding to this unit can be correctly displayed in this position. Supposing that it had been decided that the eight positions of the large display assembly with LEDs (L1) reproduced in the circle in figure 1A correspond to the eight addresses 000, 001, 010, 011, 100, 101, 110 and 111 of the memory (M) of the computer, it is first necessary to associate the data of each unit to a corresponding address. For example, it is necessary to associate the data of unit (U6) with the address 101. The association of the data of the eight units and the eight addresses can be called an "association topogram." Thus, when the data of unit (U6) are transmitted, an "address signal" corresponding to the address 101 is also transmitted.

In order that the data transmitted can be accepted by the corresponding unit, it is necessary to give each unit a respective identification code corresponding to an address. For example, it is necessary to give a respective identification code corresponding to an address to each unit. For example, it is necessary to give the unit (U6) the

identification code 101, in such a way that unit (U6) can accept the data with the address signal of address 101.

It is interesting to note that the "association topogram" does not depend on the positions of the units of the large display assembly with LEDs (L1) and the codes of the units, and does not depend on the wiring of these units. For example, if we change the wiring of the units to a series connection U1-U2-U3-U4-U5-U6-U7-U8, if the positions of the units of (L1) remain the same and if the codes are not changed, the "association topogram" of the memory (M) of the computer does not change. Or on the other hand, if the positions or the codes of the units are modified, the "association topogram" changes, even if the wiring of the units remains unchanged. The "association topogram" can be sketched by running a "topogramming program." After having introduced the data of the units and the data relating to the positions of the units of (L1) in the computer, it is simply necessary to run the "topogramming program" once, and only once; in this manner, the computer will associate the data of each unit with its corresponding address. In other words, sketching an "association topogram" in its memory. Due to the association topogram, the data of a unit are accompanied by a corresponding address signal, which makes it possible for a unit to decide whether or not the data belong to it.

If the user modifies the dimensions of the large display assembly with LEDs (L1) by adding or by eliminating certain units and not rearranging anything but the positions of the units of (L1) without adding or eliminating any units whatsoever or simply by changing the codes of the units, the association will be changed and the user will not be able to rely on the old association topogram to display the data in the correct units.

Thus it is necessary to introduce the data of the new units and the data on the positions of the units and run the topogramming program once again in order to sketch a new association topogram. By working in this way, the units recover their ability to accept or reject the data of the computer selectively.

The "topogramming program" is not absolutely necessary. If we can save an "association topogram" of the units in the memory of the computer in advance, we have no need of the topogramming program. Still, the "association topogram" must be replaced by another "association topogram" when the arrangement of the units is modified.

The "association topogram" is in fact a program which corresponds to the association of data of the units and the related address. The "topogramming program" must not be confused with the "topogram program". The topogramming program does not indicate any specific association of the units and their addresses. The "topogramming" is not a topogram, but the ability to sketch a topogram. It makes it possible for the computer to sketch the "association topogram" of the association of the units with the addresses of the computer. If we run the "topogramming program," the computer will sketch a "topogram program" of the units in its memory. The "association topogram" must be modified when the association of the units and the addresses of the computer change, but the "topogramming program" does not need to be changed every time the association changes.

In practice, the identification code of each unit is represented by the status of an address switching system containing several run/stop switches that are operated manually. If the system for switching the addresses have three run/stop switches for each unit, there would be eight

different binary codes, i.e., 000, 001, 010, 011, 100, 101, 110 and 111, each corresponding to one unit (U1) to (U8). Needles to say, the "covering" or the "collision" of codes is not authorized. In other words, two units are not authorized to include the same code, unless it is desirable for two units to always display the same models. Thus, it is necessary to give a different identification code to all of the units. If the system of address switching has eight run/stop switches, it is possible to obtain $(2)^8 = 256$ codes with eight different bits. Thus, the large display assembly with LEDs can include up to 256 units.

If more than 256 units are necessary, we can easily increase the possible codes by increasing the number of switches of the address switching system. For example, if we increase the number of switches from two to ten, we can obtain $(2)^{10} = 1024$ codes with ten different bits. Still, this measure is not preferred since a switching system with ten switches is not available on the market. The type available is an element with eight switches. Because of price, it is preferable to use the type with eight available switches. In order to employ the switching system with eight switches available for more than 256 units we can increase the number of output channels of the interface. Each output channel of the interface is connected to a group of 256, or at least 256 units. With reference to figure 1B, if we want to construct a large display unit with LEDs (L2) of 1024 units (U1) to (U1024) we can divide the units into four groups (G1), (G2), (G3) and (G4), each corresponding to 256 units, i.e., (U1) to (U256), (U257) to (U512), (U513) to (U768) and (U769) to (U1024). The number of output channels must be raised to four. The output channels (g1), (g2), (g3) and (g4) are connected, respectively, to

a group (G1), (G2), (G3) and (G4). The computer must be programmed in such a way that it can transmit the information belonging to the group, e.g., (G2) to another group (G2) by way of the correct output channel (g2). The interface (I1) of figure 1B differs from the interface (I) of figure 10 and figure 1, only in the sense that the number of its output channels can be increased. Theoretically, the number of output channels may be increased infinitely. As a result, it is possible to increase the large display assembly with LEDs (L1) up to practically any number desired by using the element with eight available switches.

As explained above, the number N of devices of a unit is preferably not too large or too small. The reason for this statement is explained below. Since each unit must have its respective control circuit, which includes a central unit CPU, a random access memory RAM, a data offset circuit, a scanning control circuit, buffers, as well as a system for switching addresses and a color brilliance switching system, if N is too small, e.g., N = 1, meaning that each unit contains only a single device with 8 x 8 dots, when we want to construct large display assembly with LEDs of 64 x 64 dots, we need 8 x 8 = 64 control circuits, and as a result 64 sets of elements, while the structure of certain elements such as the buffers, the data offset circuit and the scanning control circuit can be simpler if the value of N is smaller. The increase in cost is considerable. In addition, it takes a lot of time to control the address switching system to give each of the 64 units a respective identification code and to connect them together. If N = 8, we need only 8 sets of circuit elements; thus the cost is, by far, less elevated and we have to control only eight

identification codes and connect eight units together. Still if N is too large, e.g., N = 32, the possible combination in practice is greatly reduced. For example, if one unit contains 2 x 4 = 8 devices, we can easily increase the dimensions of a large display assembly with LEDs with 64 x 64 dots to 96 x 80 dots by adding 7 of these units to eight devices. Still if N = 32, this dimension can not be obtained. In addition, since the color brilliance of the N devices of one unit can not be controlled separately, the devices of the same unit must have the same grade. The larger the value of N, the more difficult it will be to find N devices of the same grade and the "local control" becomes more difficult. As a result, the choice of an optimum value for N is a compromise between the cost and the possibility of the dimension put together and the local control. Under consideration of all the practical factors N = 8 seems to be the optimum value.

The invention will be better understood by reading the description below established in connection with the attached drawings, in which:

figure 1A is a graphical representation showing the connection of a large display assembly with LEDs having eight units, conforming to the present invention and a computer where the association topogram of the units is sketched in its memory; the circle indicates the positions of the eight units on the large display assembly with LEDs;

figure 1B is a graphical representation of a large display assembly with LEDs having four groups of units with an interface having four output channels;

figure 1C is a graphical representation of the connection of a number of circuit boards of the interface;

figure 2 is a perspective view of a unit containing eight display devices with LEDs and matrices with 8 x 8 dots according to the present invention;

figure 3 is a perspective view of a large display assembly with LEDs formed of eight units in figure 2 and its connection to a computer;

figure 4 is a simplified and concise diagram of the control circuit of a unit in figure 2;

figure 5 is a graphical representation of the connection of input and output channels of the units of figure 1A;

figure 6 is a detailed diagram of the control circuit and contains the address switching system and the color brilliance switching system;

figure 7 is a circuit diagram showing the detailed wiring of the eight devices of one unit;

figure 8 is a data offset circuit diagram;

figure 9 is a perspective view of a dot with LEDs with a chip with diodes with red and green lights;

figure 10 is a simplified diagram of a large classic and dynamic display assembly with LEDs and dot matrices, made up of nine devices with matrices having 8 x 8 dots; and

figure 11 is a perspective view showing the large display assembly with LEDs in figure 10 and its connection to a computer.

With reference to figure 2, one unit (U) of the invention contains a display plate (27) with LEDs formed of eight devices (P11) to (P24) with LEDs and dot matrices, as well as a control circuit (CC1). A power stabilizer (S) furnishes the required power. In general, several units (for

example, ten) can share a common power stabilizer. As mentioned above, the unit has one input channel (1) and one output channel (1'), to which several similar units can be interconnected to create a large display assembly with LEDs. With reference to figure 3, a large display assembly with LEDs (L1) formed of eight units (U1) to (U8) is connected to a computer (C) by way of an interface (I) similar to the interface (I) in figure 11.

With reference to figure 4, the control circuit (CC1) of a unit contains a central unit CPU (21), a random access memory RAM (22), the buffers (23) and (24), a data offset circuit (25 or DS1) and a scanning control circuit (26 or SC1). A power stabilizer (S) supplies the control circuit (CC1). Since these elements are similar to the corresponding elements of the prior art in figure 10, their description will be reduced to a minimum in the text that follows.

As explained above, the control circuit of one unit also includes an address switching system (31) and a color brilliance switching system (32). These are connected to the central unit CPU by way of buffers (311) and (321), respectively. A control port (33) is connected to the buffers (311 and 321) respectively. The port receives the signal from the central unit CPU to control the conduction of the buffers (311 and 321) in order to allow corresponding signals to pass.

In figure 4, the input channel (1) is connected to the computer by way of an interface (I). The input channel output (1) contains a data bus (11), an address bus (12) and a control bus (13) which are connected to the input of the buffers (23) of the bus.

The buses (111, 131) of the buffer (23) are connected to the

central unit CPU (21), while the bus (121) is connected to a buffer (24), of which the output (122) is connected to the buffers (311, 321) and to the random access memory RAM (22). The three buses (111, 112 and 113) are respectively bifurcated and branched to the output channel (1'). If the data transmitted does not belong to this unit, it does not enter into its node and moves laterally, by way of the output channel (1') to the input channel (1) of the following unit. Since the data pass by a buffer (23) that has an amplifier function, when the data pass by a series of units, the data signal is not weakened by the number of units the data passes. A control bus (132) and a data bus (133) interconnect the central unit CPU (21) and the RAM memory (22). One bus (112) leads from the CPU unit (21) to the data offset circuit (25). This data offset circuit (25) transmits the data of the bus (112) to the corresponding lines of dots of the display board or device (27) with LEDs. The scanning of the lines of display (27) with LEDs is controlled by the scanning control circuit board (26) by way of the upper scanning bus (281) and the lower scanning bus (291). The scanning buses (28, 29) connect the RAM memory (22) to the scanning control circuit. The line scanning signals are transmitted from the central unit CPU (21), by the intermediary of the RAM memory (22), by way of the scanning buses (28 and 29), the scanning control circuit (26) and the scanning buses (281 and 291), to the display board (27) with LEDs to scan its sixteen lines there.

Figure 5 reproduces the detailed connection of the channels (1, 1') of the units in figure 1.

With reference to the present figure 6, both the address switching system (31) and the color brilliance switching system (32) contain

nine run/stop switches, respectively. Due to these nine run/stop switches of the address switching system (31), it is possible to obtain 256 different binary codes. Thus, a large display assembly with LEDs can also be assembled using 256 of these units. Four of the eight switches of the color brilliance switching system (32) controlling the brilliance of the red chips of the lines of this unit and the remaining four switches control those of the green chips. Due to the four switches, it is possible to obtain $(2)^4 = 16$ different degrees of brilliance. The chrominance can also be controlled by varying the proportion of the red and green light. For example, assuming that the brilliance of the red chip is the 9th degree of that of the green chip is the 8th degree, if the resulting luminance is satisfactory while the chrominance is a bit too red, we can then control the red chip at the 8th degree and the green at the 9th degree. By acting in this way, the brilliance does not change but the color can be corrected.

The data bus (112) of the central unit (31) of the data offset circuit (25) contains a data bus of red light (1121), a data bus of green light (1122), a clock data bus (1123) and a stroboscopic data bus (1124). The data buses of red and green light (1121, 1122) allow the information of the red and green compound to pass. The stroboscopic signal authorizes the information of the red and green components to be sent to the related dots when the line belonging to it is scanned.

With reference to figure 7, the scanning buses (281 and 291) coming from the scanning control circuit (26) to the display device (27) with LEDs, are connected respectively to the dots of the four upper devices (P11 to P14) and to the dots of the four lower devices (P21 to P24) to control the scanning of the large display assembly with LEDs (27).

With reference to figure 8, the four buses (1121 to 1124) are connected to the data offset circuit (25). The offset circuit (25) contains eight offset registers (SR1 to SR4 and SR1' to SR4') and eight levels of engagement (D1 to D4, red levels and D1' to D4', green levels). The red light data bus (1121) is connected only to the four offset registers (SR1 to SR4), which are connected to the red chips of the board (27), while the green light data bus (1122) is connected only to the four offset registers (SR1' to SR4') that are connected to the green chips of the panel (27). Each level of engagement has eight outputs, each connected to one column of a display board (27) with LEDs. Since the whole description of the three preceding paragraphs is referenced to a known technique and not to a part of the present invention, its details can be omitted.

The brilliance of the chip with LEDs is controlled by the length of the pulse. As explained above, the brilliance of the chip with LEDs depends on its power supply. Since the average current is directly proportional to the length of the pulses that excite the chip with LEDs, the brilliance can be controlled by varying the length of the pulses. The central unit CPU (21) can detect the status of the brilliance-color switching systems and data of the pulses of a corresponding length, by means of the red light data bus (1121) and the green light data bus (1122), to the red and green chips with LEDs, in such a way that the dot with LEDs can give the desired degree of color brilliance.

In the preferred embodiment example, the control of the color brilliance is gradual. In other words, the brilliance of the chips with LEDs is divided into sixteen different degrees. Still, if necessary, a non-gradual control is also possibly by using different conventional means.

It is interesting to note that, theoretically, the units can be connected infinitely in series in any number desired. Still, in connection in parallel, the number of units of each parallel connection location must not exceed ten since the signal of the computer is divided at each branch of the parallel circuit and may weaken. If the number of branches exceeds ten, the signal can be weakened to a degree where it is not longer operable.

To construct a large display assembly with LEDs, first we have to give 256 units different codes by adjusting their address switching system (31), then connect their ports to form a complete circuit. Then it is necessary to connect the finished large display assembly with LEDs to a computer by way of an interface and it is necessary to give the computer an "association topogram." The "topogram" can be assigned by introducing a "topogram program" into the computer memory and by running a "topogramming program" in such a way that a topogram will be sketched in the computer as indicated above.

To increase or reduce the dimensions of a large display assembly with LEDs (L'), it is possible to connect a selected number of units or eliminate a selected number of units from the original large display assembly with LEDs (L') and give the new units added their respective identification codes. If necessary, the identification codes of the old units of the original large display assembly with LEDs must also be modified. Then, we can again associate the units of the large display assembly with LEDs with the addresses of the computer and update the "association topogram" of the computer by replacing the "old topogram" with a new one, or by running the "topogramming program once again. After that, the

modified large display assembly with LEDs will become available for use.

As explained above, when more than 256 units are necessary, while using the available element with eight switches, we can increase the number of output channels of the interface. With reference to figure 1C, a circuit board (W) of the interface can contain eight output channels (g1 to g8), of which each is connected to a group (G1 to G8) of 256 units. Each circuit board (W) has one input end (X) and one output end (Y). Thus, the circuit boards (W) can be connected in series in any number desired. Naturally, the data of a specific group (e.g., the third group (G3) of the first circuit board (W)) can be transmitted to the output channel involved (g3) of the third circuit board (W) and not to the other output channels. This is controlled by the computer. By connecting three of these circuit boards, it is possible to obtain 24 output channels. This indicates that twenty-four groups or 256 x 24 = 6144 units can be incorporated in the large display assembly with LEDs.

The present invention offers several advantages in comparison to the dynamic and classic display with LEDs and dot matrices. Since the unit can be standardized, its price can be minimized. The unit can be assembled in any desired number to yield a large display assembly with LEDs of any desired dimension, without it being necessary to redesign the circuit or reprogram the software of the central unit CPU. Since the degree of the color brilliance of each individual unit can be controlled separately, the requirement imposed by the equality of the devices is not critical, since it corresponds to the case of the classic display with LEDs and the

resulting very slight inequality of chrominance or luminance at any location of the large display assembly with LEDs can be eliminated by local control. We have no doubt that the present invention constitutes a revolutionary development in the LED display industry.